RepAIR: Future RepAIR and Maintenance for Aerospace industry

The goal of this research project with twelve partners from all over Europe and from the US is the onsite maintenance and repair of aircrafts by integrated direct digital manufacturing of spare parts. Cost efficient and lightweight but robust reliable parts are obligatory for aircrafts. Additive Manufacturing allows completely new approaches: The main objective of RepAIR is to shift the 'make-or-buy' decision towards the 'make' decision by cost reduction in the remake and rework of spare parts and therefore to improve cost efficiency for maintenance repair in aeronautics and air transport.

1. Objectives

The project aims to reduce the Maintenance, Repair and Overhaul (MRO) costs with the help of the Additive Manufacturing (AM) technology as its crucial advantage is the flexible availableness allowing on-time maintenance. The technology shall help to reduce the turnaround time by a higher automation level and a reduction of the inspection time by integrating continuous health management. Further optimizations are intended for a part weight reduction and less scrap and toxic chemicals in the repair process. All in all, this will strengthen the business model of European MRO service provider in the world by integrating a complete production and supply chain for complex spare part.

2. Procedure

There are dedicated work packages for each research task. First, a requirements analysis is conducted. A decision support is developed in order to automate the cost analysis. A test rig and statistical procedures are set up to implement part monitoring and usage based lifetime prediction. An automated Direct Metal Deposition machine with integrated scanning and milling tool is being developed. Further process related parameters are derived and a part redesign is conducted. This supports also the creation of a certification and QA concept as another research field in the project. This is all integrated in the RepAIR IT management platform, a new suite that combines all steps in one software and thus supports the overall objective to reduce costs and lead time.

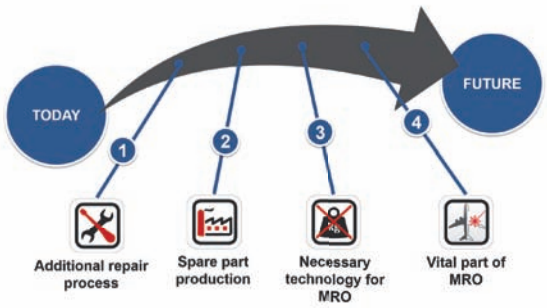

Figure 40: Future scenarios for the different integration stages of AM into aerospace

3. Latest results

In order to achieve the project's objectives a roadmap for the further progress and research needs of the considered technologies has been generated. A prototype Decision Component tool has been developed to calculate an AM part repair or production in order to determine the most cost-efficient solution. It also takes into account environmental issues to balance ecological and economical costs. A test rig was set up and a methodology has been developed to perform experiments in order to predict the remaining lifetime of a part by statistical analysis to improve the usage of parts and to map the exchange with the regular maintenance schedule of the specific aircraft. Improvements are made directly focusing on AM repair in MRO processes for high batch repair of identical parts with the design of a clamping device. The high batch repair process has been demonstrated to work properly handling the chosen sample part. An integrated 5-axis DMD/tooling machine prototype has been installed. It is capable to compare the damaged geometry with the original CAD file and to automatically calculate the milling and cladding paths to restore the part's shape. Tests for generating process parameters were started. Based upon the previously summarized regulations and requirements on the certification process, a conceptual design for a qualification process using AM has been described. A quality manual model

with specific procedures for the newly developed workflow has been derived. The MRO software has been enhanced by the various RepAIR modules and now supports the integrated repair and production process in one single application.

Within the first and second RepAIR workshop, project results available up to that point have been presented and evaluated. Key performance indicators (KPI) for management platform and sub-systems have been established. For the dissemination and exploitation of the results various activities, such as participating in conferences and fairs, have been performed. Based on the dissemination strategy, several conference presentations were given and papers were published. The exploitation plan has continuously been synchronized with individual exploitation plans of each partner.

4. Outlook

The project was finished in summer 2016 but the consortium intends to use the gained knowledge in the field of Additive Manufacturing and aerospace to continue research in these fields. Results from the RepAIR project will further be disseminated and the consortium partners will proceed with their exploitation plans.

Collaboration partners of DMRC in RepAIR

APR Srl (Italy), AIMME (ES), Avantys engineering (DE), ATOS (ES), The Boeing Company (US), Cranfield University (UK), Danish Technology Institute (DK), Lufthansa Technik (DE), O'Gayar Consulting 2009 (ES) and SLM Solutions (DE)

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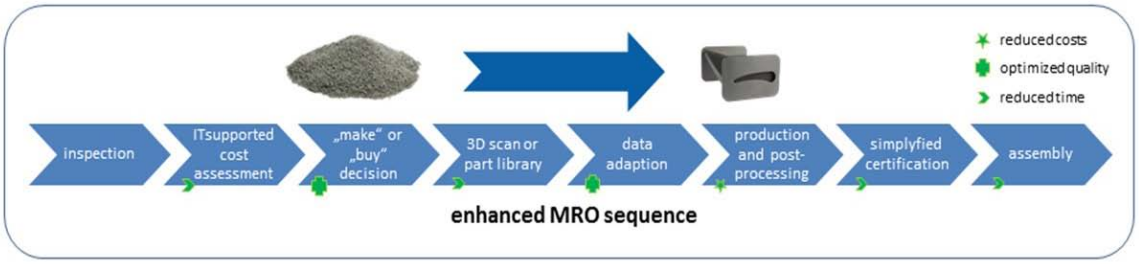

Figure 41: Enhanced MRO sequence